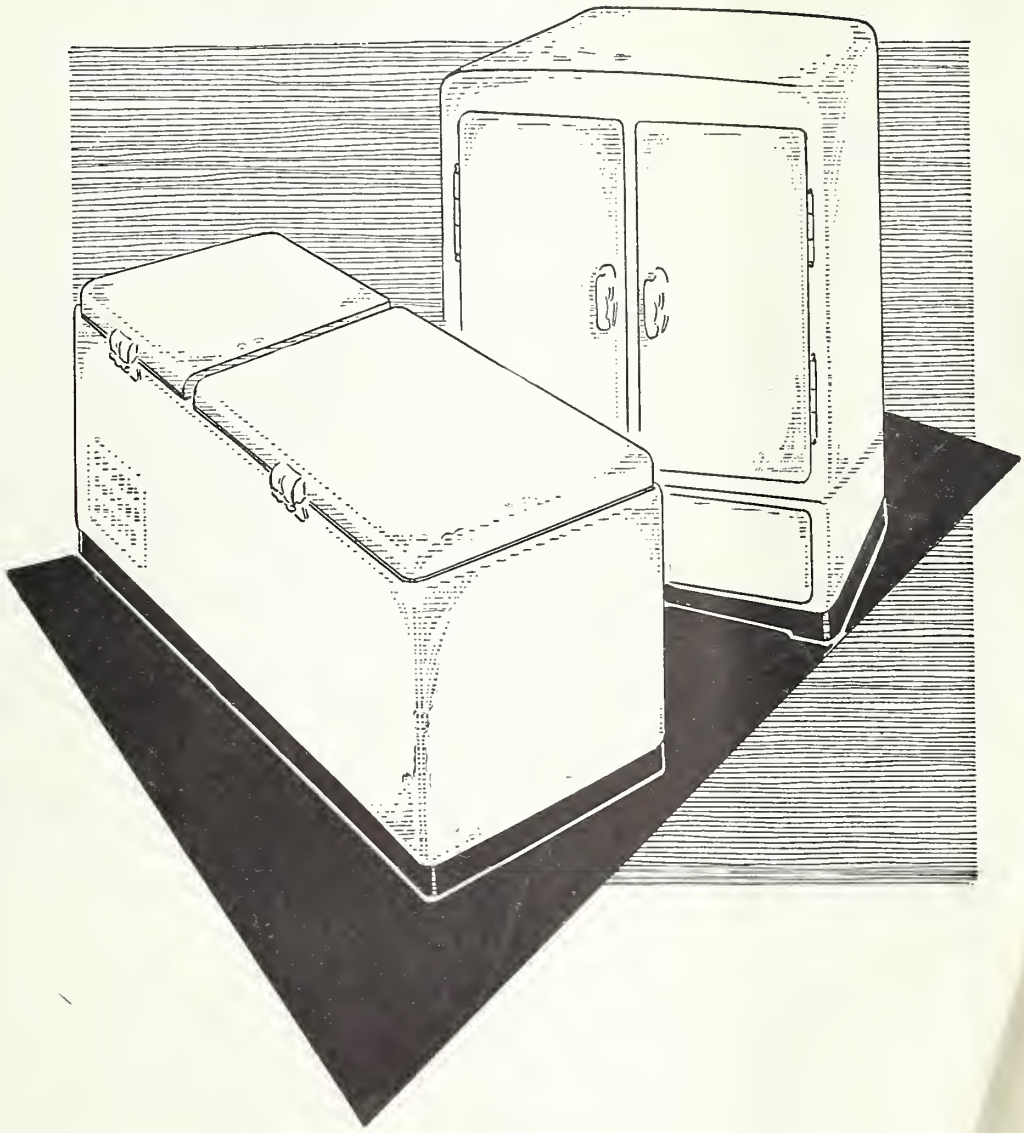
HOME FREEZERS

their selection and use



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HOME FREEZERS—THEIR SELECTION AND USE

To own a home freezer is a goal of many families. Possible benefits of freezer ownership are numerous; how great they will prove to be depends on the choice of freezer and the way in which it is used.

This publication raises some of the questions families will need to consider in their planning in order to select the frozen-food facilities that will suit them best. It takes up points of design and construction that may enter into the choice of a home freezer, and gives suggestions for using a freezer for the most satisfactory results. The publication is intended especially for teachers, extension workers, and others who help families with their buying problems.

PLANNING FOR THE FREEZER

How will the freezer be used?

Not all families will make the same use of a home freezer. Some will want to put into it as much of their food as can possibly be frozen; others will plan on freezing only certain kinds of food. In some circumstances the freezer will serve chiefly for storage of frozen foods; in others a large amount of freezing may be done.

Some families may plan to use a home freezer to supplement locker-plant facilities. To prevent loss of quality, food must be frozen soon after it is packaged, and if locker plants are not set up to do the processing and packaging, freezing food at home may be preferred to rushing each lot to the plant as it is packaged. Or if food is frozen at a locker plant, a family may want a home freezer for storage of large enough quantities so that frequent trips to the locker will not be necessary.

Even though they buy their frozen food, families may want a home freezer in order to keep a supply on hand for current needs and for emergencies. For some, a two-temperature refrigerator with *zero*-storage compartment may take the place of a freezer. A 1- to 2-cubic-foot compartment provides enough space for several days' supply of frozen food for even a large family. The food can be stored in it as long as in a separate freezer.

Control of quality of frozen foods is a factor that may lead families to decide on a home freezer. Locker plants are not always equipped to handle properly the peak load during the height of a crop season, and delay in processing and freezing food can lower the quality. Locker plants are not immune to break-down and power failure or to problems of temperature variation. Commercially frozen food, too, may have had improper refrigeration with a resultant loss of quality. For these reasons, families may prefer to do their own freezing and to store their frozen food where they can watch it.

What are the costs of owning and operating a home freezer?

In planning for a freezer, the family will need to think about costs. The freezer itself represents a substantial investment and in addition there are operating costs, overhead, and the cost of packaging food for freezing.

The purchase price of a home freezer is roughly dependent on its size. At present, freezers of 18-cubic-foot capacity cost on the average about $35 per cubic foot. As size decreases below 18 cubic feet, cost per cubic foot increases. As size increases, up to 30 cubic feet or so, cost per cubic foot decreases. To a quoted purchase price are sometimes added freight, delivery, and installation charges.

Whether to include as a cost interest on the investment is a question, as the money would not always have been invested to yield cash income or used to reduce indebtedness. If interest is included, the rate used to compute the amortization charge should be based on the return that could be obtained from some other investment.

Depreciation is a cost not to be overlooked. The life expectancy of a home freezer has not yet been definitely established, but a common estimate is 10 years.

The annual cost of repairs also can be only an estimate because of the limited period in which home freezers have been operating. Two percent of the initial cost is suggested as a fair estimate.

Cost of packaging materials runs around 2 cents a pound of food, even when outer wrappings are used more than once.

Operating costs vary, depending on such factors as size and design of the freezer, capacity of the compressor, freezer location, and the local electric rate. To freeze a pound of food and lower its temperature to 0° F. for storage, about 0.1 kilowatt-hour of electrical energy is required. Energy for maintaining zero temperature in a freezer for 24 hours can be estimated roughly as follows:

Size of freezer:	*Energy per cubic foot (kw.-hr.)*
6 cubic feet	0.35
12 cubic feet	.30
18 cubic feet	.25

For the country as a whole the average electric rate is about 3 cents per kilowatt-hour.

In the example below, the foregoing figures are used to compute a year's costs for home freezing exclusive of the cost of the food frozen. The example is based on use of a $400, 12-cubic-foot freezer (360-pound capacity), with three conditions—no turn-over of frozen food and with turnovers of 50 percent and 150 percent. Since all costs, except those for packaging and freezing food, remain the same regardless of the quantity of food in the freezer, the higher the rate of turnover, the lower the cost per pound of frozen food, as shown:

Expenditure item:	*360 lb. of food*	*540 lb. of food*	*900 lb. of food*
Amortization charges (3 percent interest, 10 years' life expectancy)	$46. 89	$46. 89	$46. 89
Repairs (2 percent of purchase price)	8. 00	8. 00	8. 00
Electricity—			
For freezing food (0.1 kw.-hr. per lb. at 3 cents per kw.-hr.)	1. 08	1. 62	2. 70
For maintaining 0° F. (0.3 kw.-hr. per cu. ft. per 24 hr. at 3 cents per kw.-hr.)	39. 42	39. 42	39. 42
Packaging (2 cents per lb.)	7. 20	10. 80	18. 00
Total cost	102. 59	106. 73	115. 01
Cost per pound of food	. 28	. 20	. 13

Locker-plant costs, for comparison with home freezer costs, can easily be computed from the plant's rates for locker rental and charges for the services provided.

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If a home freezer is used in conjunction with locker-plant facilities, costs for each will of course need to be considered. The total will depend on whether food is frozen at the locker plant and the home freezer used chiefly for storage or the food is frozen at home and the main supply stored in the locker. Many locker plants make a freezing charge for all the food handled, whether or not it has been frozen before it is placed in the locker.

The expense of trips made especially to take food to and from the locker plant may well be charged against the cost of the frozen food.

Is home freezer ownership a paying proposition?

It is often said that it pays to own a home freezer—that a family can save on its food budget by buying foods cheaply in large quantities at the height of a season . . . can have better food at less cost.

From the standpoint of raising levels of living there seems to be no doubt that ownership of a home freezer can be profitable. From a straight dollars-and-cents standpoint the answer is not so clear. The figures show that the cost of freezing and storing a pound of food is a considerable item. Whether, in the long run, the family's food budget will be reduced or increased by use of a home freezer, depends on whether food is homegrown or purchased, kinds and quantities of food frozen, and how the freezer is used. Obviously, it would not pay to freeze foods that are commonly available and relatively inexpensive at all seasons.

To make a freezer pay for itself requires careful planning. The family that lives out of the freezer so far as possible is usually the one that gains the highest dollars-and-cents return on the investment. This calls for a well-thought-out freezing schedule based on a food-production plan that meets the family's needs. Best practice, as the cost figures indicate, is for rapid turn-over of food in the freezer. This means using stored food, not saving it—often one of the hardest lessons for the freezer owner to learn.

Families that have poultry or other produce to sell can sometimes increase their profits through the use of the home freezer and so make the equip-

ment a paying proposition. Poultry, for example, may be frozen and held for a better market.

In any event, for many families financial considerations will be overbalanced by the convenience of the home freezer, the saving of time in marketing and meal preparation, and the satisfaction of enjoying throughout the year a variety of fresh-flavored foods of high nutritive value.

How large a freezer does a family need?

The question of size is one of the first to consider when a family is planning to buy a home freezer. The amount of space needed depends on the kinds and quantities of foods to be frozen and stored in a year and the rate of turn-over. That in turn depends on such factors as size of the family, source of foods, and length of time between growing seasons.

Most home freezers range in size from about 3 to 30 cubic feet of food-storage space. A cubic foot is about four-fifths of a bushel. To convert size in cubic feet to capacity in pounds of food, common practice is to multiply by 35. However, if the freezer is filled with a miscellany of foods in a variety of packages, the number of pounds per cubic foot may not be more than 30 or 25. If much of the food is light in weight, like baked products and whole meals, the average will be even lower—and it often happens that as a family grows into the use of a freezer more and more lightweight specialty items are frozen.

Six cubic feet of freezer space per person will meet the requirements of most families. If freezing is to supplement other methods of food preservation, or if a locker plant is to serve as the main means of storage, 3 cubic feet per person will usually be an ample allowance for the home freezer. When most of the food for the family's year of eating is to be stored in the home freezer and there is much overlapping of storage times for the various foods, 10 cubic feet per person may not be excessive.

Some families may prefer two medium-sized freezers to one large one, and for some the largest size in home freezers may not provide sufficient space. There are certain advantages in having two freezers. One can be used primarily for freezing and the other for storage. When the food supply gets low all can be stored in one freezer and the other disconnected, so that operating costs are reduced. In case of failure of one mechanism, only part of the total frozen food supply has to be taken care of. Although the initial cost is greater for two small or medium-sized freezers than for one large one providing an equal amount of space, the advantages may outweigh the cost factor.

Where will the freezer be placed?

"Where can we put a home freezer?" is a question for families to think about before buying. The ideal location, from the operating standpoint, is a cool, dry, well-ventilated place.

The higher the room temperature, the more the motor must run to maintain the freezer temperature and the greater will be the cost of operation and wear and tear on the mechanism. However, it is bad practice to put the freezer where the temperature falls below 40° F. unless it is specifically designed to operate at low temperature. At low temperatures the freezer mechanism may fail to function properly.

Dampness may damage not only exposed metal surfaces but also the motor, motor supports, and springs. In a damp place moisture is likely to condense on the freezer's outer walls and may even drip to form pools on the floor.

Circulation of air is needed to carry off the heat of freezer operation. Therefore a freezer should not be fitted tightly into a niche with walls on three sides.

Another requirement for the freezer location is a floor strong enough to support the weight. Freezers are heavy, even when empty, and a full load of food may add several hundred pounds. Upright freezers put more weight per square foot on a floor than horizontal ones of the same capacity. A solidly built floor will reduce the noise of freezer operation.

Convenience of location is a point for the homemaker to consider but usually is not of major importance, since a freezer need be opened only once or twice a day. From the standpoint of use, the kitchen or utility room may be the best place, but in many homes these rooms have no space for additional large equipment. Moreover, a kitchen or utility room is likely to be warm, and the operation of the freezer will only add more heat.

A basement generally offers more in the way of space than kitchen or utility room. Often it has the lowest temperature in the house, although if there is a furnace, this may not be true in winter. A disadvantage of having the freezer in the basement is the inconvenience of carrying the food up and down stairs. If the basement is the chosen location, stairs that are well-lighted and safe are essential as an accident-prevention measure.

A basement that is very damp, or one that is sometimes flooded, is not a good choice. Generally it is difficult to repair a motor that has been flooded, and if water gets into storage compartments, food is likely to be spoiled.

A garage attached to the house may be a satisfactory place for the freezer. It is fairly convenient and ordinarily the temperature will not fall low enough to interfere with freezer operation. In some parts of the country a shaded porch may be suitable, or a shed or other outbuilding may be used, provided it meets the general requirements as to dryness and temperature.

Before freezer and location are decided on, it is wise to take measurements to be sure that the freezer will fit the space and that it will go through doors and narrow passageways, around corners, and up or down stairs if necessary. Getting a freezer into a basement is sometimes a special problem.

SELECTING THE FREEZER

Although the home freezer industry is relatively new, the wide acclaim given to frozen foods has led many manufacturers into the field. Each has his own ideas of the size and features that will meet the requirements of the greatest number of families. Consequently the number of makes and models on the market is large. However, in any one community the available models meeting a family's specifications may be quite limited in number.

In making a selection, one of the first things to think about is, of course, how the freezer will fit into the family's plan—that is, whether it will provide the amount of freezing and storage space needed.

An equally important consideration is the future need for repair service. The buyer will do well to choose a freezer made by a company likely to continue in the home freezer business. Otherwise he may find himself with an "orphan" freezer that will be hard to keep in repair because of difficulty in getting replacement parts.

The dealer's ability to comply with any warranty or guarantee and to give prompt service is also a factor in deciding on the make of freezer to buy.

The manufacturer commonly guarantees to repair or replace without charge any part of a freezer that proves defective in material or workmanship within 1 year of the date of purchase, or any part of the sealed mechanism that proves defective within 5 years.

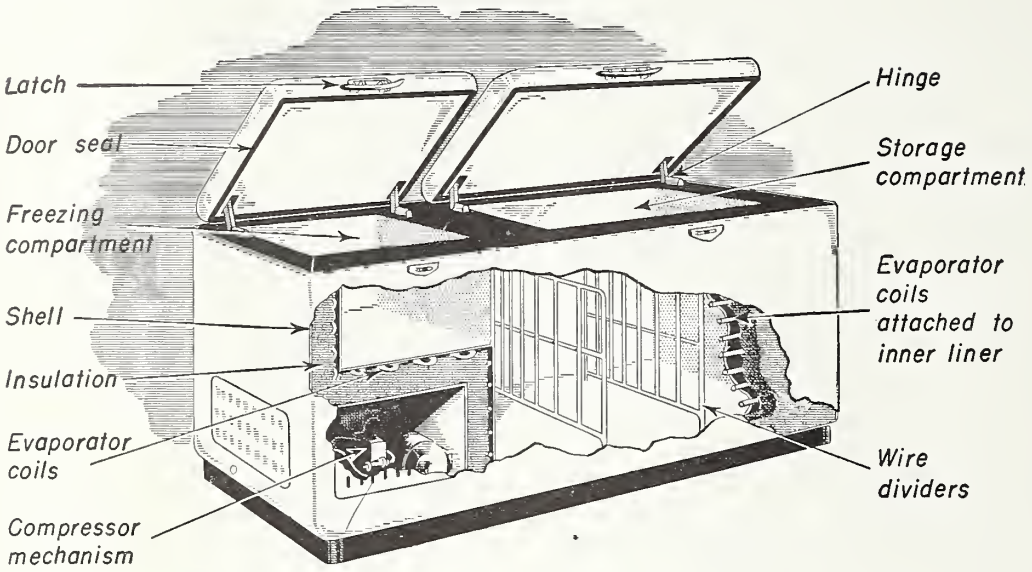
Some freezers carry an additional guarantee for a year or longer against loss of food resulting from nonoperation of the freezer, whether due to mechanical break-down or to power outage. Occasionally this guarantee takes the form of insurance.

A dealer sometimes offers special service to protect the freezer user from loss. He may keep a stand-by freezer or two on hand for his customers to use in emergencies, or he may supply dry ice, or arrange for use of locker-plant facilities.

If several models are equally suited to the family's needs and if provisions for service are equally satisfactory, then design and construction features, operating characteristics, and convenience-in-use features will be the basis of choice. These features are discussed on the following pages.

Some of the features that need to be considered can be seen and judged, but for assurance of quality in materials and workmanship, the buyer must depend to a large extent on the manufacturer. The experience of others in using home freezers is often helpful in evaluating the special features and operating characteristics of different makes and models.

CHEST FREEZER



Cabinet Design

The freezer cabinet, in which food is stored, consists of outer walls (a shell) and inner walls (liners), separated by insulation. The interior may be a single compartment or, in large freezers, the space may be divided into several compartments. Arrangements differ in different models.

In some freezers a freezing compartment, separate from the storage section, is provided.

Chest and upright freezers

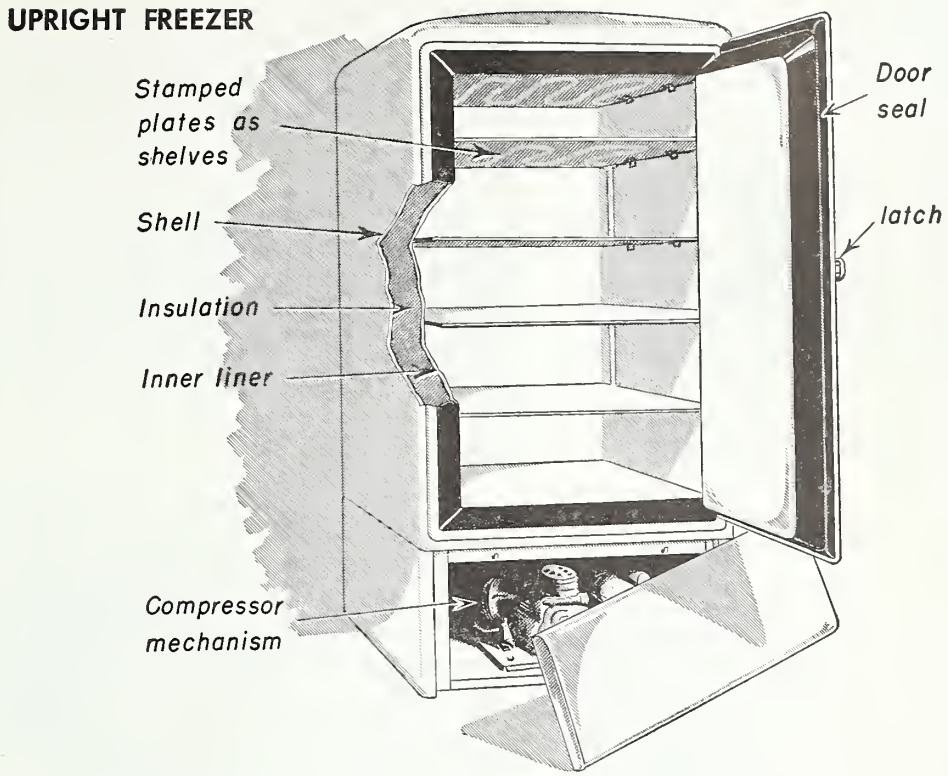
In general design, home freezers fall into two classes—chest and upright. The chest freezer is low, with top opening; the upright is higher and opens at the front. If equally well built, the two types will operate equally well. The choice depends chiefly on the family's preference. The following are points that may enter into the decision.

Space requirements.—An upright freezer occupies less floor space than a horizontal one of the same capacity, but additional space must be allowed for the doors to swing open. Chest freezers, generally counter height, provide work space—often an advantage in a kitchen or utility room.

Cost.—An upright freezer usually costs a little more than a chest model. For equally effective operation, more costly construction is required in the upright type.

A freezer that opens at the top has a natural advantage in maintaining low temperatures. When its lid is lifted there is very little exchange of cold dry freezer air with warm moist outside air, since cold air is heavier than warm. With an upright freezer, cold air tends to spill out when the door is opened and warm air comes in to take its place. Also, in an upright freezer the heavier hinges and supports required for the front-opening door conduct more heat to the inside of the freezer.

Convenience.—Whether one type of freezer is more convenient than the other is largely a matter of personal opinion. A carry-over of ideas gained from using a household refrigerator leads many persons to conclude that food stored in an upright freezer will be more easily accessible. However, problems in using refrigerators and freezers are quite different.



When a freezer is closely packed there can be no reaching over tops of packages in front to get at those in the rear. To remove inner packages, those in front must be taken out and, if all shelves are full, placed outside the freezer where temperature is relatively high. In top-opening freezers, packages taken out in order to reach the lower layers can be placed on those in another section, even though the section is full, and will not warm up as much.

In a chest freezer the hardest place to reach is the back part of the bottom. In an upright freezer the back part of the top and bottom shelves are the least accessible. When a family is considering different models, it is a good idea for the persons who will use the freezer most to try reaching various locations to find out which designs are most convenient for them.

Some upright freezers have drawers instead of shelves so packages at the rear can be reached readily, and some chest freezers are equipped with baskets to make it easier to get packages at the bottom of the freezer. Although drawers and baskets are convenient, they use space otherwise available for storage—sometimes as much as a cubic foot. Also, baskets, if fully loaded, may be difficult to lift.

Irregularly shaped packages create more of a problem in an upright than in a chest freezer. They do not stack well and tend to slide out of an upright freezer when the door is opened. Particularly is this true if a door is frosted shut and has to be jarred or jerked loose.

Generally speaking, frost collects more rapidly in an upright than in a chest freezer. However, the upright is easier to defrost, especially when the shelves are refrigerated. The frost can be scraped to the front of the freezer where it can be taken out easily. In the chest freezer frost falls to the bottom of the compartment as it is scraped from walls or dividers and is more difficult to remove. A few chest freezers have drains at the bottom so that water can conveniently be used in defrosting.

Separate freezing compartments

A freezer with separate freezing compartment is a wise choice for the family that plans to freeze food at home instead of using a locker service.

A freezing compartment is one separated from the rest of the freezer space by insulation or by a refrigerated surface. This compartment is designed to be the coldest part of the freezer, so that food will freeze more quickly in it than elsewhere.

Equally important is the fact that the separate freezing compartment protects stored frozen food from excessive temperature changes while other food is being frozen. Temperature rise in stored food is less when the freezing load is kept completely separate than when freezing is done in the compartment in which the food is stored.

Points on Construction

Outer walls of home freezers are generally of metal coated with porcelain or synthetic enamel, although a few manufacturers are making them of stainless steel. Enameled cabinets are commonly white to match standard kitchen equipment. The base metal is most often steel but sometimes aluminum or aluminum alloy. All these materials have proved satisfactory. A point for the buyer to check is whether enameled steel has been treated to resist corrosion in case the coating is scratched through or chipped.

Liners are porcelain enamel, aluminum with a nonoxidizing finish, or aluminum alloy. Rounded corners make for ease in cleaning.

Toe space is a convenience in working at a chest-type freezer.

An inside light may be a desirable feature, particularly if the cabinet is in a poorly lighted place.

Insulation

Adequate insulation is essential to efficient freezer operation. Several kinds of insulating materials are suitable for home freezers; those commonly used are of similar insulating value.

With any material, the thicker the insulation, the more economically a freezer will operate. However, thicker insulation means either a decrease in food-storage space or an increase in the over-all size of the cabinet. In order to provide maximum storage space within the limitations of exterior dimensions that are practical and convenient in a home freezer, most manufacturers use from 3 to 6 inches of insulating material.

If the compressor unit is at the bottom of the freezer, at least as much insulation is needed between it and the food-storage compartment as in other parts of the freezer. Otherwise heat from the compressor may make the bottom of the compartment too warm for satisfactory storage of frozen food.

In localities where electric rates are relatively high—above 4 cents a kilowatt-hour—thickness of insulation may be a major factor in the choice of a freezer. However, other factors such as efficiency of the mechanism and design of the freezer also affect operating costs.

Sealing of outer shell

Sealing of the outer shell so that water vapor cannot pass into the insulation is important in freezer construction. The difference in temperature between the outside and inside of a freezer causes a difference in water-vapor pressure, resulting in a force that tends to drive water vapor into the freezer. Under normal conditions of operation this force is equivalent to a 70-mile-an-hour wind; in many cases it is even greater.

If water vapor gets between the freezer walls, it will eventually be deposited as ice and water and will destroy the effectiveness of the insulation. Therefore, the purchaser should ask whether precautions have been taken to vapor-seal the outer shell. The sealing can be done in several ways.

Doors and door seals

Home freezer cabinets, whether chest type or upright, may have either flush or recessed doors. The difference in design can be seen in the diagrams on page 9. Provided the doors are well built and tight fitting, the two types are equally satisfactory.

Large freezers are often built with multiple doors. An upright freezer sometimes has a single outer door and multiple inner doors. With multiple doors, only one section of the food compartment need be opened at a time and less warm air will enter the freezer. However, the fewer the outer doors, the less heat leakage there will be around them.

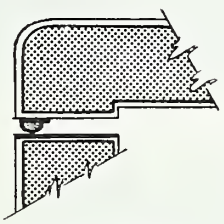
To reduce passage of water vapor and heat into a freezer, a door seal is provided. This is ordi-

narily a flexible rubber or plastic gasket. A single seal consisting of one narrow gasket is most common, although some manufacturers use a double seal made up of two narrow gaskets, or a wide single seal.

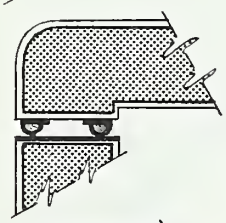
The double seal is more effective than the narrow single seal in keeping heat out of the freezer. However, any water vapor that passes the first gasket may be deposited between the two gaskets in the form of water and possibly freeze later; this makes it difficult to open the door of the freezer.

In contrast, the water vapor that gets by a single seal continues into the interior of the freezer and is deposited there as frost.

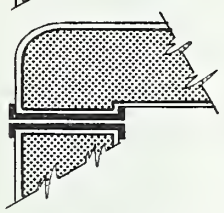
DOOR SEALS



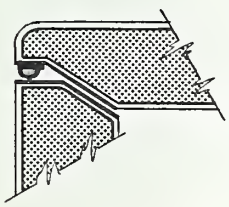
Flush type with single seal



Flush type with double seal



Flush type with wide single seal



Recessed type with single seal

Recessed type with double seal

The wide single seal, if properly constructed, reduces both heat leakage and accumulation of moisture or ice between the surfaces.

Essential for safety is a device to hold the door of a chest-type freezer open while food is being put in or taken out. Counterbalancing hinges are often used, especially when the freezer has a single door. With multiple doors, the total weight is divided and danger of serious accident is lessened.

With a counterbalanced lid or with a front-opening door, a tension latch is necessary to produce a good seal. Since the latch must be tightly closed to be effective, the ease of fastening is something for the freezer buyer to notice. Latches on most freezers have to be fastened by hand; some freezers have latches that catch automatically when the door is closed.

Hardware

Hardware on a home freezer needs to be rugged to stand up under the use and conditions to which it is subjected. Since the outside of a freezer usually sweats, hardware should be rust-resistant. An upright freezer needs heavy hinges to keep the door from sagging.

A lock may be wanted, especially if the freezer is to be kept in a garage or on a porch.

Refrigerating Mechanism

In a home freezer, as in a mechanically operated household refrigerator, refrigeration is produced by causing the refrigerant to change from a liquid to a gas and back again to a liquid. As the liquid refrigerant circulates through coils adjacent to the food compartments, under low pressure, it boils (changes to a gas), absorbing heat in the process. Then, under increased pressure, the gas changes to a liquid, giving up heat.

The refrigerating mechanism includes compressor, condenser, expansion device, and evaporator. The course of the refrigerant as it circulates and changes from liquid to gas is shown by the diagram on page 10.

An automatic device that starts and stops the motor as the temperature changes controls freezer temperature. Most controls can be set by the user for the desired temperature.

Compressor

The compressor is the heart of the refrigerating mechanism—the part that keeps the refrigerant in circulation. Two kinds of compressor units are in general use in home freezers, the hermetically sealed unit and the open type.

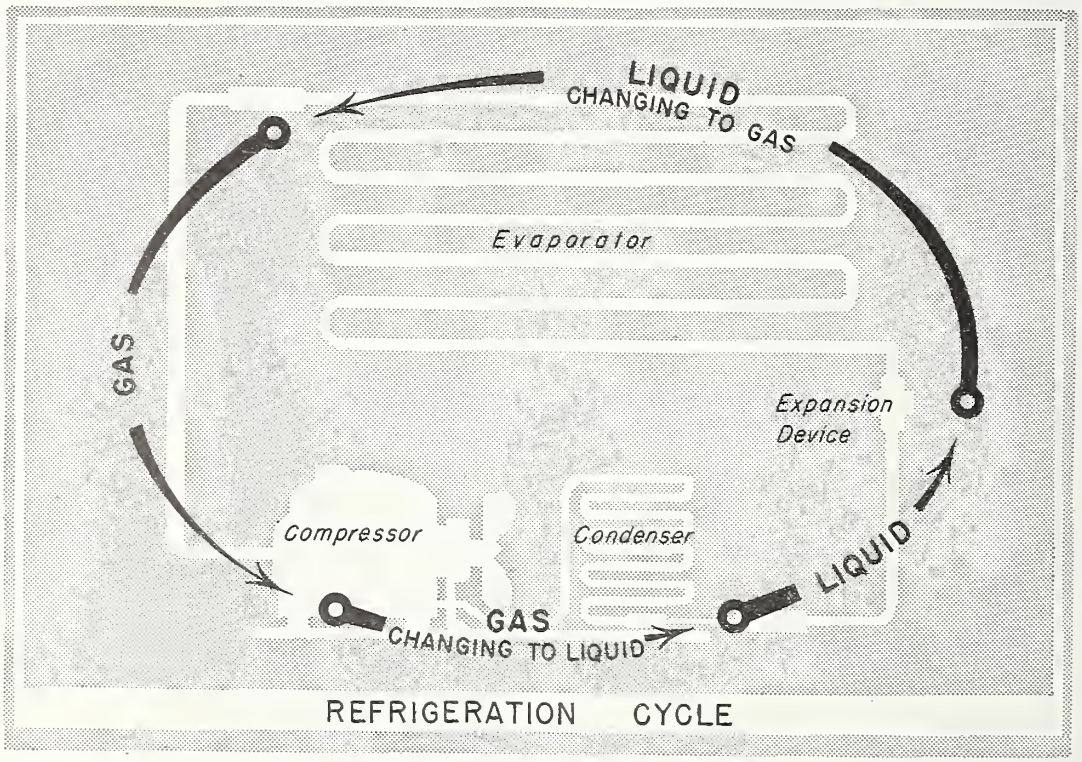
A hermetically sealed unit consists of motor and compressor sealed in a gastight compartment. A separate motor is required for operating a condenser fan. The sealed unit is more compact and quieter in operation than the open type. There is no danger of refrigerant leakage. The unit needs no oiling for the lubricant is sealed in. The unit must be returned to the factory for repairs and replaced entirely if it fails.

In the open-type unit, motor and compressor are connected by a belt. The fan that blows air through the condenser coils is usually attached to the motor shaft. There is a possibility of refrigerant leakage at the compressor shaft seal. The unit requires oiling.

An open unit usually costs a little more than a hermetically sealed unit. In general it will operate more efficiently, although the belt may break and cause temporary failure of the mechanism. Repairs to an open unit can usually be made by a local serviceman.

In either type of unit, the motor should have an overload cut-out switch for protection against excessive current flow.

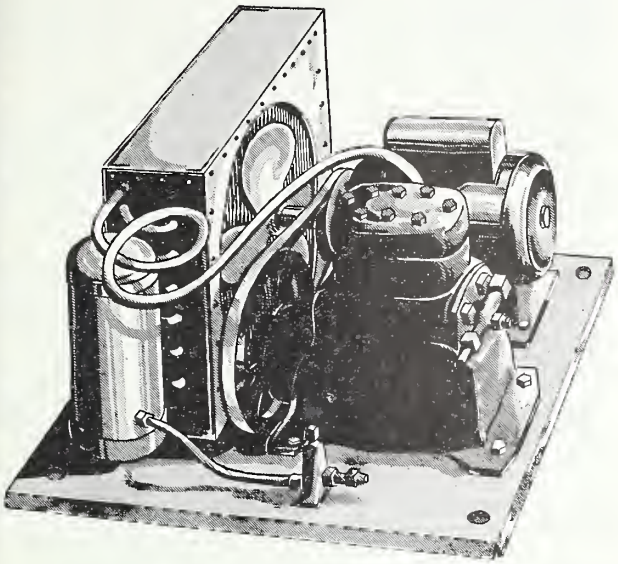
On freezers up to 20-cubic-foot capacity, motors of ⅛ to ¼ horsepower are generally used; on 15- to 30-cubic-foot freezers, the motor is usually ¼ to ½ horsepower. This overlapping of size is due to differences in design among freezers and to differences in manufacturers' ideas of how a freezer will be used. For maintaining storage temperature only, less power is required than for both storing and freezing food. Therefore, if the man-



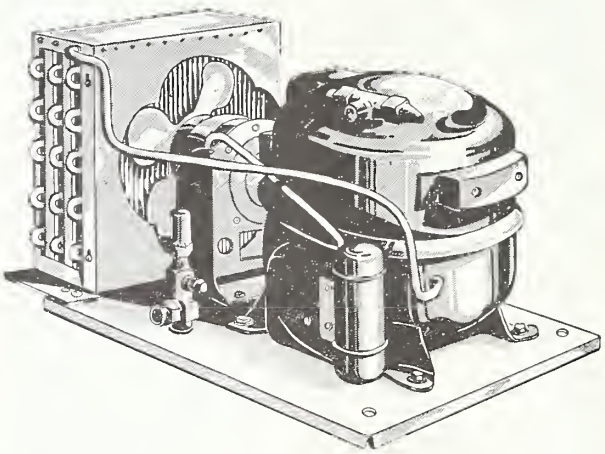
The compressor takes the refrigerant, in the form of gas, from the evaporator (low-pressure part of the system) and forces it into the condenser (high-pressure part). Here pressure and temperature conditions cause it to condense—change to liquid—giving off heat in the process. The expansion device regulates flow of the liquid refrigerant into the evaporator where it absorbs heat from the food compartment in changing again to gas. The "spent" gaseous refrigerant is then returned to the compressor. These expansion and compression processes take place simultaneously while the motor is in operation.

COMPRESSORS

Open type



Hermetically sealed type



ufacturer thinks of his freezer chiefly as a storage cabinet he tends toward the lower powered compressor; if he thinks that a considerable amount of freezing will be done, he uses the higher powered unit.

A compressor unit that will run no more than 50 percent of the time in a temperature of 90° F. when no freezing is being done will give best all-round mechanical performance. Such a unit will provide enough refrigerating power for maintaining storage temperature in the cabinet, with a sufficient reserve to take care of recommended freezing loads and any abnormal conditions requiring extra refrigeration. The buyer can find out from the manufacturer or dealer what percentage of the time the compressor runs.

The buyer will need to find out also about operation of the compressor while food is being frozen. Freezing results are best when the unit runs without stopping during the entire freezing period, so that heat is removed from the food continuously until the freezing load is reduced to storage temperature.

Condenser

The condenser is the mechanism in which heat absorbed by the refrigerant is removed. It generally consists of coils with heat-dissipating fins and may be fan-cooled or gravity type. In a fan-cooled condenser, a motor-driven fan forces air through the coils to cool them. A gravity-type condenser is set at an angle so that the natural flow of air can cool the coils. Compressor units with gravity-type condenser usually cost slightly more to operate than those with fan-cooled condenser.

Evaporator

The evaporator is made up of coils through which the refrigerant circulates. The coils may be in the form of tubing attached to the liners or they may be stamped into plates that are used as liners or as dividers or shelves.

The area of the evaporator surface is one of the factors that determine how efficiently a freezer will operate. All other factors being equal, the freezer with the largest evaporator surface is the one to be preferred. A small evaporator must have a much lower temperature than a large one to produce a given freezer-air temperature, and requires more extensive compressor operation. Also, the lower the evaporator temperature, the greater the tendency of the food in the freezer to dry out.

Information about relative areas of evaporator surface in different models can be obtained from

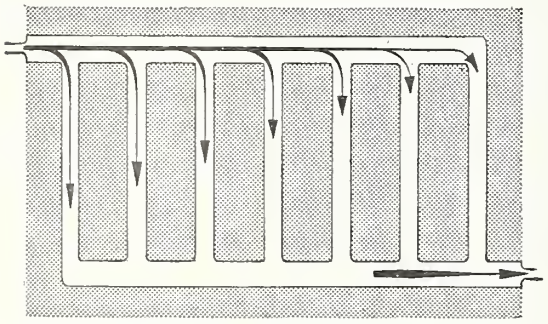
the dealer or manufacturer. Length of evaporator coils or number and size of stamped plates is an indication of evaporator size.

Attached coils.—The attached-coil evaporator consists of metal tubing attached to freezer liners by soldering or brazing or by clamps. Heat transmission is best when the coils are soldered or brazed to the liners along their entire length, and not so good when the coils are fastened only at intervals by clamps or soldering.

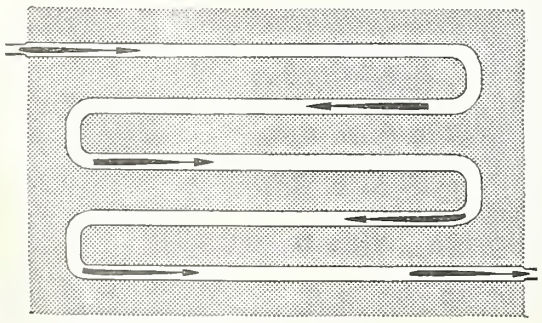
Tubing attached to liners is most used in chest freezers. Upright freezers sometimes have attached coils on three sides and sometimes on the top liner or the bottom of the food compartment also.

Stamped plates.—A stamped evaporator plate is made of two sheets of metal, one of which is stamped to form coils that carry the refrigerant. The coils may form either a continuous serpentine path or parallel paths running between headers at opposite ends or sides of the plate. In general the serpentine path gives the better distribution of the refrigerant.

The stamped-plate evaporator is somewhat more expensive to construct than the attached-tubing type. It is usually slightly more efficient since the refrigerant path is a part of the liner or divider.



Parallel refrigerant paths



Serpentine refrigerant path

Stamped plates may be used as liners in either chest or upright freezers. In chest freezers, plates may form vertical dividers, extending either from side to side or from front to back. In upright freezers, stamped plates may be used in horizontal position as shelves; often an additional plate is placed at the top of the freezer.

Advantages of the stamped plate as divider or shelf are that both sides provide refrigerated surfaces and that the plates are readily accessible for repair. A disadvantage is that the necessary piping reduces food-storage space.

When shelves are refrigerated, food in storage is more likely to be affected by temperature changes during the operating cycle than when liners or dividers form the evaporator surfaces, since packages make firmer contact with horizontal than with vertical surfaces.

Freezer alarms

Even though a freezer owner is careful to check on freezer operation each day, temperature rise can be so rapid in some parts of the freezer that a signal to give warning when something is wrong is a desirable feature.

The alarm should give the warning signal before the warmest package in a partly loaded freezer reaches 15° F.; otherwise some of the food may reach such a high temperature that it would be unwise to refreeze it. If an alarm is installed after the freezer is purchased, the best place for the sensitive bulb that controls it is against a back liner level with the top layer of packages when the freezer is full.

Other desirable features in an alarm system—

- A signal that is audible rather than visible—and loud enough to be heard readily.
- An alarm that signals either when the circuit is broken or when the temperature rises above normal operating temperature.
- Connections that interfere as little as possible with gasket seals.
- Manual means for turning off the signal and for testing the alarm system.

Whether built into the freezer or installed later, the alarm system will need an occasional checking. This can be done by warming the sensitive bulb, either by taking it out or by other means, to see whether it is working.

USING THE HOME FREEZER

Before installing a freezer the user will need to make certain that the motor is designed for the electric system in the home. The motor name plate gives the information needed about the type of current and voltage required.

In a basement or other place that may be damp, it is a good idea to set the freezer on a low platform.

The home freezer should always be grounded to prevent possibility of shock to the user.

Packaging food for freezing

The purpose of packaging food for freezing is not merely for ease in handling; it is primarily to keep food from drying out. Food not adequately protected will lose quality and nutritive value in spite of all the care that is taken otherwise and in spite of the efficiency of the freezer. Consequently, it pays to use good-quality moisture-vapor-proof packaging materials. Poor-quality wrappings or makeshift materials are not an economy in the long run.

Even with vapor-proof packaging, some moisture will come out of the food and appear in the package as frost. The more air space in the package, the more frost there will be. Hence when cartons or other containers are used, they should be packed to eliminate as much air as possible; irregular pieces such as meats that are not put into containers should be closely wrapped.

Loading the freezer

The quantity of food that can be frozen successfully at one time depends on the kind of food, size and kind of package, and design of the freezer. When food freezes too slowly, loss of quality or even spoilage may result. However, if freezing is completed within 24 hours, it is difficult for even an experienced judge to detect differences in palatability of foods frozen at different rates.

The manufacturer's directions usually recommend a maximum load for a particular freezer and state where the load should be placed. It is generally advisable to limit the freezing load to one-fifteenth or, at most, one-tenth of the total capacity of the freezer, as that is usually the maximum quantity of food that can be frozen and reduced to storage temperature in 24 hours.

The purpose of limiting the freezing load is to prevent too great a temperature rise in the freezer and to guard against too slow freezing. During the freezing period the food compartments usually warm up and generally do not return to initial temperature until all the food has been reduced to storage temperature. If a second load should be put in before the first is completely frozen, as might happen at times when freezing is done every day, that load would raise the temperature still higher, and so on for each successive day of freezing.

For quickest possible freezing each package should be in direct contact with a refrigerated surface. If packages are massed together, those at the center may not freeze fast enough to keep the food from spoiling. Leaving a little space between packages, where feasible, to allow for circulation of air, is a good practice.

Storing frozen food

The freezing compartment of a home freezer is generally less satisfactory for storing frozen foods than are the compartments designed especially for storage. Temperature variation during cycling is usually greater in a freezing compartment, and in case the freezer fails to operate separate insulated freezing compartments are generally more vulnerable to temperature rise. When it is necessary to use the freezing compartment for storage, it is wise to store there the packages of food that will be among the first to be used.

Regulating freezer temperature

Authorities agree that a storage temperature no higher than 0° F. is needed to maintain satisfactory quality in frozen food. Manufacturers aim to meet that standard, but their statements about the maintenance of certain temperatures are meaningless unless conditions are defined and the places where temperatures are taken are known.

The temperature at any point in a freezer is the average of the highest and lowest temperatures at that point during a cycle of operation. There-

fore, average zero at a point means that the temperature may be above zero roughly half of the time and below zero the other half. Since the average temperature varies from point to point in a freezer, the average obtained for the whole freezer depends on what points are selected. (As yet there is no standard method of taking temperatures although various organizations and agencies are working on the problem.)

By taking temperatures in different parts of the storage compartment, the freezer owner can find out how the temperature varies from one point to another. It is good practice to keep a thermometer in the warmest location in the freezer and try to hold the temperature at that point close to zero at all times by adjusting the control for different loads and different room temperatures.

If the compressor does not operate continuously while a load is being frozen, the temperature control will need to be set at its lowest position during the freezing period to insure continuous compressor operation.

Some manufacturers advise turning the control to its coldest position several hours before a load is to be frozen. In that way the storage load will be lowered well below its normal temperature and any warming during the freezing period will bring it up only to normal or slightly above.

Defrosting

Frost and ice on freezer liners and dividers mean that the compressor is having to do extra work. The thicker the deposit, the more the compressor has to run to maintain the required temperature.

Defrosting should be done before there is more than ½ inch of frost over a considerable area of the refrigerated surfaces. Ordinarily defrosting about once a year is enough. If humidity is high or if the freezer is opened often, another defrosting or two during the year may be called for. If possible, choose a time for defrosting when the quantity of food in the freezer is relatively low.

A deposit of frost alone can be removed while the freezer is in operation, by scraping the surfaces. If the freezer is not too full, food packages need not be taken out; they can be moved from one part of the freezer to another as work progresses.

Special scraping tools are on the market, or a broad stiff spatula, a putty knife, or a sharp-edged wooden paddle may be used. The frost can be caught on papers, cardboard, or cloths as it is scraped from walls or vertical dividers, or collected from the bottom of the freezer with a dustpan and whisk broom. If dustpan and broom are kept cold, the frost will not melt as it comes in contact with them. Frost on refrigerated shelves can be scraped directly out of the freezer. Drawers in a freezer are generally removable to give access to the side walls.

If the deposit contains ice, or if a complete job of cleaning is needed the following procedure is recommended.

Remove all food packages and disconnect the freezer. Place the packages on trays or in baskets that have been thoroughly cooled in the freezer. Pile the packages as compactly as possible to reduce the amount of exposed surface, and cover with chilled blankets or other insulating material such as newspapers.

Scrape as much frost as possible from the surfaces so there will be less to melt off. If the freezer has a drain, run cold water over the refrigerated surfaces to hasten the melting. Hot water should never be used, as refrigerant pressure would be built up in the evaporator and cause difficulty in starting the compressor. An electric fan placed so it will blow room air into the freezer or cold air out will help in melting the ice. Removing the ice from the surface at intervals, as it loosens, speeds the defrosting process. Do not chip it off with an ice pick or other sharp tool that might damage the coils.

While defrosting is going on wipe up water from melting frost and ice with cloths, and clean the nonrefrigerated surfaces. After defrosting and cleaning are completed, connect the freezer and let it run half an hour or so to bring the temperature down somewhat before putting the food back in.

When returning the food to the freezer it is a good idea to take an inventory and place older packages at the front or top or earmark them in some way for first use.

What to do in case of nonoperation

When a freezer fails to operate, the difficulty may be in the mechanism or in the electric circuit. The first thing to do is to look for clues as to what may be wrong.

With an open-type compressor unit, if the motor is running but a high freezer temperature indicates that no refrigeration is taking place, the belt may be broken. Putting on a new one will remedy the trouble.

If the belt is still in place but not moving, it may need tightening. This can usually be done by sliding the motor on its base. However, it is often best to replace the belt since it may have been weakened by the rotation of the motor pulley against it. The worn belt can be kept for temporary use in emergencies.

If tightening the belt or putting on a new one does not remedy the difficulty, the compressor valves may be stuck. For this and any other causes of nonrefrigeration in an open-type unit, a serviceman will be needed.

When a hermetically sealed unit is running and no refrigeration is taking place, the only thing to do is call a serviceman.

If the freezer motor is not operating, first be sure the plug is properly in the outlet—the connection may have been broken even though the plug has not fallen out. Then try a lamp or other appliance in the outlet. If it doesn't work look for fuse trouble. If the fuse is all right there must be trouble farther back in the line. If there is no electric current at the main switch, it means that the power is out.

In case of power outage, try to find out how long it is likely to continue. If only a few hours no precautions need be taken. If longer, the best procedure is to use dry ice. One 50-pound cake will be enough to protect a freezer up to 36 hours. Saw or chop the dry ice into pieces proportional to the sizes of the storage compartments. Never handle dry ice with bare hands—it may cause burns.

If any stored food is in the freezing compartment, move it quickly into the storage compartment before putting in the dry ice. Place the dry ice on boards on top of the packages, not directly on the packages. Do not open the freezer again until it is necessary to put in more dry ice or until the freezer has been in operation for a few hours. If dry ice is used, covering the freezer with blankets helps to retard rise of temperature in the freezer. Blankets alone have little or no effect.

ADDITIONAL PUBLICATIONS

Other publications on equipment and home freezing available from the Office of Information, United States Department of Agriculture, Washington 25, D. C.

How to Choose and Use Your Refrigerator. AIS–56.
How to Choose and Use Your Washing Machine. AIS–73.
Home Freezing of Fruits and Vegetables. AIS–48.
Chicken in the Freezer. AIS–74.

CONTENTS

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